A Preliminary Report on Modern Carbon Datings at Syowa Station and its Neighbourhood, East Antarctica

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東南極昭和基地および周辺地域のモダンカーボンの測定（予報）

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要旨：昭和基地の周辺地域では，大陸氷床が融解しており，海水中の放射性炭素の濃度は，他の中緯度地域の濃度に比し，低濃度を示すことが予想された．オングル島やスカルブスネスなどでは，N. B. S. 蓚酸の C-14 濃度の 95％ をモダンカーボン値として年代が決定されている．今回オングル島の東で採水した海水は，従来の報告にない低い C-14 濃度〔2860 ± 125 yrs. B. P. (δ C-14: −292 ±11)〕を示した．大気中の C-14 濃度に比し，海水中の C-14 濃度が異常に低く，しかも大陸氷床から離れるにつれてその濃度が高まることは，古い大陸氷床の融解に伴う海水中の C-14 濃度の稀釋効果と解釈される．このような低い C-14 濃度の海域に棲息している生物体の C-14 濃度もまた中緯度地方の生物体の C-14 濃度に比し低いことが予測される．従って南極地域における C-14 年代測定に際しては，まず当該地域のモダンカーボン値や，大陸氷床から年代測定試料採取地点までの距離を検討した上で慎重に行なわれるべきである．

1. Introduction

The author spent 13 months (1969–70) at Syowa Station (lat. 69°00′S, long. 39°35′E) in East Antarctica and studied coastal geomorphology of the Sôya Coast and glacial and sub-glacial geomorphology along the traverse route to the Yamato Mountains. The shore terraces along the Sôya Coast were described by T. Yoshikawa and H. Toya (1957). Some of the shells in these shore terrace deposits were collected and dated by T. Nagata and Y. Yoshida (1962), H. Meguro, Y. Yoshida, T. Uchino, K. Kigoshi and K. Sugawara (1964) and by Y. Yoshida (1970). These datings were done by the radiocarbon method, and the ages were calculated using the activity of the 95% of N. B. S. oxalic acid standard as the modern carbon standard activity.

Formerly, E. A. Olson and W. S. Broecker (1961) reported on the low C-14

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concentration in the Antarctic sea water and the seal sample. In the Sôya Coast, a very old ice sheet hanging at the coastal rise is floating out and being melted. It is expected that the modern carbon concentration off the Sôya Coast must be lower than in mid-latitude, unless there was rapid mixing of the sea water. If such an assumption is correct, it is dangerous to conjecture the geomorphological development of the area with the radiocarbon data before establishing the contemporary modern carbon standard in the Sôya Coast. However, there was no report on the modern carbon standard for the Sôya Coast, so the author tried to date the modern carbon samples before describing the chronology of the area. This report presents the modern carbon data on the sea water, lake water, and atmospheric CO_2 at Syowa Station and its neighbourhood.

2. Collection of the Samples, Analysis, and the Results of Dating

The author collected modern carbon samples of sea water, lake water, atmospheric CO_2, raised marine plants, and remains of Adélie penguins. The sampling

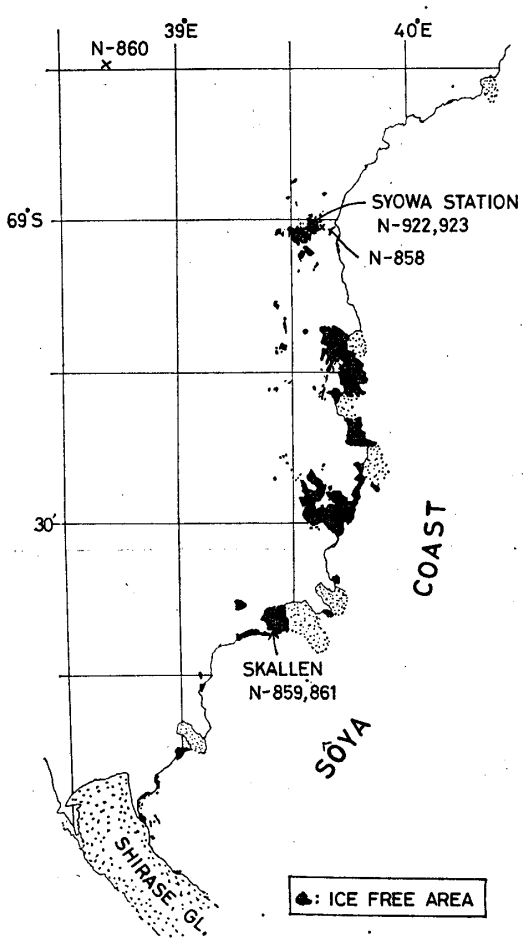

Fig. 1. Index map of the sampling sites (results of sampling N-858, 859, 860, 861, 922 and 923 are shown in Table 1).

sites are shown in Fig. 1. The Antarctic sea water samples of 200 *l* each were pumped up from a depth of 10 meters below the surface and the lake water samples were collected from one of the glaciated lakes, named Shiro-ike (temporary name) in Skallen, 0.5 meter deep from the surface. Each water sample was preserved in a polyethylene bottle. In the meantime, atmospheric CO_2 was absorbed in 2*l* of 2 N–8 N NaOH solution in a plastic tray, which was exposed to the atmosphere for 10 days in every month at Syowa Station.

The chemical analysis and the radiocarbon assay were carried out by Dr. and Mrs. T. HAMADA, at the Institute of Physical and Chemical Research, Tokyo. The carbon dioxide was extracted from each water sample by acidifying with sulphuric acid and bubbling with nitrogen. The atmospheric CO_2 samples were treated with 1 N HCl solution to release CO_2 which is to be absorbed in NH_4OH. The reaction was as following; $CO_2 \rightarrow (NH_4)_2CO_3 \rightarrow CaCO_3 \rightarrow CO_2$. Then the carbon dioxide was transferred into 2.7 *l* proportional counter and counted for about 1000 minutes. The results are shown in Table 1.

Table 1. Results of the modern carbon dating at Syowa Station and its neighbourhood.

Code No.	Sample	Locality (depth)	C-14 age (δ C-14‰)*
N-858	Sea water	69°01.0′S, 39°36.5′E (−10m)	2860±125 yrs. B. P. (−292±11)
N-860	Sea water	68°44.5′S, 38°42.0′E (−10m)	880±115 yrs. B. P. (−101±12)
N-859	Lake water	69°40.0′S, 39°23.5′E (−0.5m)	Modern (+278±19)
N-861	Lake water	69°40.0′S, 39°23.5′E (−0.5m)	Modern (+253±19)
N-922	Atmospheric CO_2	69°00.0′S, 39°35.5′E (+10m a. s. l.)	Modern (+487±17)
N-923	Atmospheric CO_2	69°00.0′S, 39°35.5′E (+10m a. s. l.)	Modern (+315±45)

* All dates are based on the Libby value, 5570 ± 30 yrs., for the half-life of C-14.

3. Discussion and Summary

The principles and the basic concepts of the radiocarbon dating have been studied and reported by many scientists, and the reliability of the determined radiocarbon age has been raised gradually. The results of the radiocarbon dating have brought a remarkable progress in the chronological studies of late Quaternary archaeology, geology, and geomorphology.

In this paper, the author would like to point out that the concentration of C-14 of the sea water in the East Antarctic area is different from that in the other area. W. S. BROECKER and E. A. OLSON (1961) dated the Antarctic sea water samples from surface to bottom. Their result of the analysis did not show the uniform distribution of C-14 either vertically or horizontally. They tried to date some Antarctic samples (L-462 B, 462 E, 594, 627, and etc.), based on the concentration of radiocarbon in flippers of freshly killed seals which showed "the low C-14 concentration (δ C-14: -148 ± 7) that resulted in an apparent radiocarbon age of 1300 years for the marine organism living in the area".

The present results indicate that only sea water samples were not in "modern carbon age". And it is noticeable that the results also differ from the results of E. A. OLSON and W. S. BROECKER (1961), showing smaller δ C-14 than the present results. Sample N-858 was collected from Ongul Strait, 4 km from the continental ice sheet, while the other sample (N-860) was collected at a site 80 km far from the continental ice sheet. The difference between the two sea water samples suggests slight mixing of freshly melted water originated from old ice sheet with oceanic water.

It is necessary in the near future to correct the whole data of the carbon dates in Antarctica already obtained, based on the carbon age of modern samples. After those corrections, it would be possible for the geomorphologists, geologists and glaciologists to discuss precise chronology, isostatic uplift and eustatic sea-level changes in Antarctica. The distance between the sampling site and the continental ice sheet should be considered when the radiocarbon age was younger than the present result (N-858) in the Sôya Coast, and also when the sampling site was close to the continental ice sheet in other areas.

The lake water samples were both in "modern age". The results prove that the lake water has been fed by melting of snowfalls after the retreat of the continental ice tongues in Skallen. And the results of the atmospheric CO_2 would be explained by the result of global circulation.

The radiocarbon data on the modern carbon samples in Antarctica may be different regionally. The author considers that the differences would exist especially in the area very close to the ice sheet in the marine samples, because in the Antarctic sea where many old ice sheets are floating out and being melted, the organisms living there must have low C-14 concentration in their bodies. But the studies on the Antarctic modern carbon samples are few. The author needs to date much more modern samples in Antarctica before establishing the chronology of the Sôya Coast.

Acknowledgements

The author wishes to express his hearty thanks to Dr. K. KUSUNOKI, leader, and the members of the 10th Japanese Antarctic Research Expedition, to Captains S. MATSUSHIMA and H. ISOBE and the crew of ice breaker FUJI for the co-operation rendered to his field work. Also he wishes to express his hearty thanks to Professor T. YOSHIKAWA, University of Tokyo, who kindly guided and encouraged the author in the study of Antarctica. Dr. and Mrs. T. HAMADA, Institute of Physical and Chemical Research carried out the carbon dating, and Professor T. KUBOZOE, Technological College of Defence Academy, suggested the author how to absorb the carbon dioxide of the air. Professors K. NISHIMURA and T. NOH of Tohoku University and their staff encouraged the author while he was in Antarctica. And the author wishes to express his appreciation to Professor K. KIGOSHI, Gakushuin University, for his critical comments on C-14 and reading of the manuscript.

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(Received September 25, 1971)